(Original Translation)

Lighting Element Comprising An Inserted Light-Guiding Body

Description:

Method for the production of a lighting element comprising at least one luminescent diode and an inserted light-guiding body, which is arranged in front of said luminescent diode in the direction of the exit of the main light, wherein the respective luminescent diodes are connected to the inserted light-guiding body by an injection molding process with transparent plastic.

Such a method for the production of a lighting element is known from the German patent specification DE 101 63 117. Here, a first LED-partial body is permanently connected to a second, larger light-guiding body by injection molding. However, a special component is used here as the LED-partial body. This solution also results in portions of large material build-ups in the injection mold. This requires *inter alia* a longer cooling-off time and brings about an uneven cooling.

Therefore the problem underlying the present invention is to develop a method for the production of light-guiding lighting elements by using at least one inserted light-guiding body, wherein the transparent partial illuminating bodies are connected to one another in a safe, rapid and precise manner with respect to the form thereof with the usual capacity of the known injection methods.

This problem is solved using the characteristics of the main claim. For this purpose, at least 50% of the surface of the light-emitting diode is covered by the injection material during injection molding. At the same time, the maximum wall-thickness of the injected layer does not exceed three-times the minimum wall-thickness of said layer.

In vehicle lights, the connection of different optical elements makes available several interfaces, which keep the degree of efficiency low in relation to the light efficiency and the intensity of emission. An improvement of the degree of efficiency is achieved if a closed optical body having only one exit opening of the main light is produced. The use of light-emitting diodes enables the creation of such bodies. However, such lights are not yet producible economically in the required size with the current technological means in the field of injection molding technology.

The method described herein enables the economic production of large-volume lights. For this purpose, inserted bodies having light-emitting diodes are jointly coated by means of injection molding in at least one injection molding process step. The arrangement and the respective form of the corresponding preliminary step parts *inter alia* in the injection mold determine the quality and the economic efficiency of the method.

The method is also applicable on luminescent diodes having several chips and electrodes.

Further details of the invention are clear from the dependent claims and the following description of several schematically illustrated example embodiments.

Figure 1: Brake light in cross-section;
Figure 2: Partial longitudinal section of figure 1.

Figures 1 and 2 show e.g. a raised automobile brake light as the lighting element (70). The lighting element (70), which is arranged here, for example, with the help of a housing (50) in the trunk lid (60) of the motor vehicle, is made of a group of individual lighting elements (10), wherein every element (10) comprises at least one LED (11). The lighting element (70) has a diffusing screen (40), the outer surface of which is adapted to the shape of the surrounding surface curvature of the trunk lid (60).

In this context, the individual LED (11) can be a standard LED or a preliminary stage LED. The latter is produced e.g. only for installation in the brake light (70). The LED (11) usually comprises the electrical terminals (1, 4) located in one plane, the light-emitting chip (6), a bond wire (2) and a reflector dish (5). The latter is e.g. a part of the cathode (4). The chip (6) is seated in the reflector dish (5). The chip (6) contacts the anode (1) using the bond wire (2). The bond wire (2) is thereby preferably located in the plane, which is defined by the centerlines of the electrodes (1, 4). The zone located above the chip transports the light emitted by the chip (6) losslessly, as far as possible, to the outer surface (12) of the LED (11).

The standard LED used in figure 1 has, for example, a geometric form, which is substantially made of three geometric bodies arranged on top of one another. The first geometric body is a short, at least approximately straight cylinder (13), which comprises, if desired, two planar flat portions, which are aligned e.g. parallel to the LED centerline (7). The second geometric body is a truncated cone (15) arranged on the upper end face (14) of the cylinder (13) or a comparable rotational body, which tapers away from the cylinder (13). The third geometric body is a calotte and/or a comparable rotationally symmetrical cap, which is positioned on the upper, smaller end face of the truncated cone. The surface line of the truncated cone thereby passes tangentially into the contour of the cap. The upper end face (14) of the cylinder (13) is larger than the lower end face of the truncated cone (15). The centerlines of the cylinder (13) and of the truncated cone (15) are located on the LED centerline (7).

If desired, a notch (16), a channel or a waist, cf. dashed line of figure 2, which ends on the end face (14) is present in the lower regions of the truncated cone (15).

Should the individual lighting element (10) be used in a group of several individual lighting elements, the LEDs (11) are arranged e.g. on a lamellar circuit board (18). For this purpose, for example, they are soldered permanently on the circuit board (18) after being previously glued thereon. The circuit board (18) connects the individual LEDs (11) using superimposed conductor tracks. If desired, even other electronic components such as, e.g. multipliers, blocking diodes or integrated

circuits are arranged on the circuit board (18). The circuit board (18) positions the LEDs (11) in relation to one another and later - during the coating - in the injection molding device. If desired, the electrodes (1, 4) of the LEDs (11) are also discretely connected electrically using individual cables.

The inserted light-guiding body (21) located opposite to the respective LED (11) has, e.g. the shape of a partial paraboloid, which is flattened on both sides and also truncated at the top and at the bottom. The flattened lateral surfaces (26, 27) are located approximately parallel to a midplane, which is located according to figure 1 on the centerline (7) of the respective individual lighting element (10). The minimum distance of the lateral surfaces (26, 27) from the midplane amounts, e.g. to 50% of the maximum LED diameter or the maximum LED width. In the example embodiment, the distance between the lateral surfaces (26, 27) is larger towards the main light exit surface (41).

A spherical concave recess (25) is present in the end face (24) of the lower truncation according to figure 2. In this context, the recess (25) is curved in such a way that the gap (19) lying between the recess (25) and the LED (11) has an at least almost constant width.

The other end face (23), located at the top here, is planar and oriented normal to the centerline (7) of the individual lighting element (10). If desired, a short pin (29), cf. figure 2, is molded in the middle region, e.g. centrally, wherein said pin facilitates the handling and positioning

when coating by means of injection molding. The length of the pin (29) - measured in the longitudinal extension along the centerline (7) - is shorter than the thickness of the diffusing screen (40) in the vicinity of the pin. A transparent, e.g. colorless plastic is provided as the material for the diffusing screen.

Should several individual lighting elements (10) be combined in a group (70) and should these (10) be located adjoining one another, they are connected to one another using at least one web (28). In this context, the webs (28) have, e.g. a semi-circular cross-section. The webs (28) adjoin flush to the end faces (23) wherein they form a planar or curved surface with the latter.

For the purpose of coating by means of injection molding, the circuit board (18) is inserted with the LEDs (11) and the group consisting of inserted light-guiding bodies (21) into an injection mold. In this context, the distance of individual LED (11) from the inserted light-guiding body (21) at the narrowest place amounts to between 0.3 mm and 3 mm. The injection mold is designed in such a way that the finished injected layer for each pair of LED and inserted light-guiding body in turn forms a partial paraboloid (30), which is flattened on both sides and truncated at least at the top. The lower edge of this partial paraboloid rests against the LED (11) below a plane, which firstly goes through the center of gravity of the LED chip (6) and secondly is aligned normal to the centerline (7). In the example embodiment, the lower edge (32) of the injected layer (30) rests against the end face (14) of the cylinder (13) of the LED (11). For example, the edge (32) is located

directly in the geometrical cut edge, which is formed by the penetration of the cylinder (13) and of the rotational body and/or of the truncated cone (15).

The surface of the partial paraboloid (30) is located at a distance from the surface of the partial paraboloid of the inserted light-guiding body (21), said distance corresponding to e.g. two-times the width of the gap (19). The injected layer (30) has an almost constant wall-thickness over large regions. In zones of strong curvature, the wall-thickness can increase up to three-times the width of the gap. These small differences in the wall-thickness enable a production of the individual lighting element (10) without any problems.

The injected layer (30) positively engages behind the corresponding LED in case of LEDs having a notch (16). The inserted light-guiding bodies (21) can also have notches, channels or annular grooves of the same function. E.g. a colorless, transparent plastic is used for the coating by means of injection molding.

Figure 2 illustrates the injected layer (30) only in case of the first inserted light-guiding body (21).

In another step, the diffusing screen (40) is sprayed onto the end surfaces (23) of the inserted light-guiding body (21) in the embodiment. In this context, the diffusing screen (40) engages around the injected layer (30), e.g. in the upper fifth part. The diffusing screen (40) accordingly covers the inserted light-guiding body (21) on the end face (23) and the injected layer (30) on the upper edge

completely. It has a flange-shaped installation edge (42), which is parallelly displaced in relation to its main light exit surface (41) and which surrounds the entire brake light (70). The main light exit surface (41) is designed with a smooth or structured surface. For example, a red, transparent thermoplastic is used as the material.

The light-guiding and current-carrying components (11, 21, 30, 18) of the middle, raised brake light (70) are surrounded by the housing (50) on the rear side cf. figure 1. The housing (50) made, e.g. from a metal, is a dish which can be closed with a lid. In this context, the lid is a diffusing screen (40) seated, e.g. tightly on the dish. For this purpose, sealing contours (45, 51) contacting one another flatly are embodied on the diffusing screen (40) and on the housing (50). For the protection of these sealing contours (45, 51) and for holding a sealing ring (48), the housing (50) is partially guided around the diffusing screen (40) as a supporting edge, cf. figure 1.

The brake light (70) is installed in the trunk lid, in the tailgate or on the rear roof edge in such a way that the surface of the diffusing screen (40) adjoins tangentially to the surface of the autobody sheet steel (60) carrying the brake light (70). In this context, the autobody sheet steel (60) can also be manufactured from a non-metallic material. The diffusing screen (40) is inserted from the rear side together with the housing (50) into a recess (61) and is clamped there by means of a leaf spring (63) (with a e.g. two-fold curvature here) against a mounting bracket (62), which is stationary in relation to the autobody sheet steel (60). In the installed state, the recess (61) is

sealed by the diffusing screen (40) and the sealing ring (48) resting on the flange-type edge (42) of the diffusing screen (40) against the intrusion of water and dirt.

In order to create the typical appearance of a middle brake light, the colors of the individual components (11, 21, 30, 40) can be used in different variations.

Certain substances, which change the wavelength of the light emitted from the chip (6) can be admixed to the materials of the individual transparent components of the brake light (70), as a result of which the subjectively recognizable luminous color corresponds to that of a typical brake light (70), although the material of the unlighted brake light has another color, e.g. the color of the surrounding autobody sheet steel.

An individual lighting element (10) can naturally also be used separately.

List Of Reference Numerals:

1	Terminal, anode, electrode
2	Bond wire, aluminum wire
4	Terminal, cathode, electrode
5	Reflector dish
6	Chip
7	Centerline
8	Material, white, transparent
9	Material, red, transparent
10	Individual lighting element
11	LED, luminescent diode, diode
12	LED surface
13	Cylinder
14	End face
15	Truncated cone
16	Notch, channel, waist, annular groove
18	Circuit board
19	Gap
20	Group of inserted light-guiding bodies
21	Inserted light-guiding body
23	End face, top; truncation
24	End face, bottom; truncation
25	Recess, concave
26	Lateral surface, flattening
27	Lateral surface, flattening

28 Web

29 Pin

30 Injected layer, partial paraboloid, truncated

32 Edge, bottom

40 Light lens, diffusing screen

41 Main light exit surface

42 Installation edge, flange-formed

45 Sealing contour

48 Sealing ring

50 Housing, dish

51 Sealing contour

52 Support edge

60 Autobody sheet steel, trunk lid

61 Recess

62 Mounting bracket

63 Leaf spring

70 Lighting element, brake light